Proper Motions of the three close Polar Stars Groombridge 1119, *Groombridge* 2283, *and Groombridge* 3548.

(*Communicated by the Astronomer Royal.*)

These three stars, as well as Bradley 1672 and Bradley 3147, were added to the Greenwich Clock Star list in 1896, for use in the determination of azimuth error. The stars have been very frequently observed at Greenwich during the years 1887–96, and the right ascensions and north polar distances deduced for the forthcoming new Ten Year Catalogue (1890) are taken as the standard places with which those of each of the other catalogues are compared. The proper motions of the two Bradley stars are given by Professor Auwers, and in order that the three Groombridge stars may be used for azimuth determination, it is necessary that their proper motions should also be well determined.

The right ascensions and north polar distances have been brought up to 1890 with Struve-Peters precessions, from Groombridge, Pond, Radcliffe, and as many later catalogues as were easily accessible. The precessions were computed by the trigonometrical method as given in Chauvenet's Astronomy, p. 615. The convenient arrangement of the computations given in the introduction of Carrington's Catalogue of Circumpolar Stars (1855) was adopted, and use made of the tables there given for facilitating the computation.

A correction to the right ascensions of $\frac{1}{4}\,\theta^2 \sin 2a$, where θ denotes the angle between the mean equator of the date of each catalogue and the mean equator of 1890·0, was applied to the right ascensions, as this term is omitted in Carrington's formula. No systematic corrections have been applied to any of the catalogues used.

The right ascension and the north polar distance for 1890, as determined from each of the catalogues employed, was subtracted from the corresponding right ascension and north polar distance of the Greenwich ten year 1890. The proper motions deduced from each catalogue were combined with weights proportional to the product of the number of observations and the difference of epoch. The names of the catalogues, the mean dates of the observations, the number of observations, and the right ascension and north polar distance for 1890, (i) before applying proper motion, (ii) after applying proper motion, are given below.

The Greenwich right ascensions, north polar distances and proper motions for 1890·0, are

Name of Star.	R.A. 1890·0. h m s	P.M. s	N.P.D 1890·0. ° ′ ″	P.M. ″
Groomb. 1119	7 46 51·53	−0·1198	1 2 26·24	−0·020
Groomb. 2283	15 12 49·87	−0·0072	2 20 41·51	−0·031
Groomb. 3548	21 21 28·45	+0·0319	3 25 9·33	−0·018

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Groombridge 1119.

Catalogue.		Mean Date of Observations.	No. of Observations.	R.A. 1890 Uncorrected for Proper Motion. h m s	Secs. of R.A. 1890 Corrected for Proper Motion. s	Mean date of Observations.	No. of Observations.	N.P.D. 1890 Uncorrected for Proper Motion. ° ′ ″	Secs. of N.P.D. 1890 Corrected for Proper Motion. ″
				7 46				1 2	
Groombridge	1810	1807·1	6	67·75	57·80	1807·1	9	28·65	26·99
Pond	1832	1832·1	4	63·61	56 66	1832·2	10	27·82	26·66
Radcliffe	1845	1850·6	70	56·59	51·86	1849·5	43	26·92	26·11
Paris	1845	1850·7	10	56·16	51·44	1847·1	2	27·0	26·14
Carrington	1855	1855·0	27	55·05	50·85	1855·0	27	26·77	26·07
Greenwich	1860	1857·1	5	52·73	48·78	1857·1	5	26·41	25·75
Paris	1860	1860·2	14	50·99	47·41	1856·9	41	26·6	25·94
Brussels	1865					1862·4	4	26·84	26·29
Harvard	1865	1863·7	33	53·89	50·73				
Greenwich	1872	1871·8	8	52·92	50·74	1873·3	9	26·46	26·13
Paris	1875	1877·3	33	51·43	49·91	1876·6	17	26·58	26·31
Greenwich	1880	1883·4	6	50·18	49·39	1882·6	13	26·35	26·20
Williams College	1885	1884·4	25	52·59	51·92				
Greenwich	1890	1893·0	419	51·17	51·53	1893·1	374	26·18	26·24

Proper Motion $\begin{cases} \text{R.A.} = -0^{s}\cdot1198 \\ \text{N.P.D.} = -0''\cdot020 \end{cases}$

Groombridge **2283.**

Catalogue.		Mean Date of Observations.	No. of Observations.	R.A. 1890 Uncorrected for Proper Motion. h m s 15 12	Secs. of R.A. 1890 Corrected for Proper Motion. s	Mean date of Observations.	No. of Observations.	N.P.D. 1890 Uncorrected for Proper Motion. ° ′ ″ 2 20	Secs. of N.P.D. 1890 Corrected for Proper Motion. ″
Groombridge	1810	1808·1	8	45·85	46·44	1808·1	8	44·59	42·05
Radcliffe	1845	1850·5	47	51·02	51·30	1848·9	11	42·20	40·93
Carrington	1855	1855·0	12	49·54	49·79	1855·0	12	42·20	41·11
Greenwich	1860	1860·3	2	49·98	50·19	1860·0	6	42·11	41·18
Greenwich	1864	1863·5	9	49·13	49·32	1864·0	12	42·58	41·77
Harvard	1865	1864·2	30	49·66	49·85				
Brussels	1865	1867·4	2	48·58	48 74	1864·5	2	41·77	40·98
Greenwich	1872					1868·6	5	43·11	42·45
Harvard	1875	1873·0	8	49·55	49·67	1873·0	6	42·75	42·22
Greenwich	1880	1886·8	3	49·61	49·63	1886 2	5	41·67	41·55
Williams College	1385	1885·3	22	49·48	49·51				
Greenwich	1890	1893·0	232	49·90	49·88	1893·1	205	41·41	41·51

$$\text{Proper Motion} \begin{cases} \text{R.A.} = +0^{s}\cdot0072 \\ \text{N.P.D.} = -0''\cdot031 \end{cases}.$$

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Groombridge 3548.

Catalogue.		Mean Date of Observations.	No. of Observations.	R.A. 1890 Uncorrected for Proper Motion. h m s	Secs. of R.A. 1890 Corrected for Proper Motion. s	Mean date of Observations.	No. of Observations.	N.P.D. 1890 Uncorrected for Proper Motion. ° ′ 3 25 ″	Secs. of N.P.D. 1890 Corrected for Proper Motion. ″
				21 21					
Groombridge	1810	1807·8	7	25·41	28·01	1807 8	7	11·50	10·02
Radcliffe	1845	1850·9	70	27·20	28·45	1849·4	24	10·35	9 62
Carrington	1855	1855·0	19	27·71	28·83	1855·0	19	9·25	8·62
Brussels	1865	1864·5	6	27·58	28·39	1866·2	2	9·86	9·43
Greenwich	1867 & 1868	1867·7	2	28·14	28·85	1868·0	2	9·28	8·88
Harvard	1875	1873·5	10	27·77	27·98	1873·5	6	8·04	7·74
Greenwich	1880	1886·8	3	26·91	27·01	1886·5	7	9·49	9·43
Williams College	1885	1884·7	20	28·29	28·46				
Greenwich	1890	1894·2	155	28·54	28·44	1893·4	79	9·28	9·34

Proper Motion $\begin{cases} \text{R.A.} = +0^{s}\cdot0319 \\ \text{N.P.D.} = -0''\cdot018 \end{cases}$

The Binary Star h 5014. By R. T. A. Innes.

This star is identical with Piazzi 17^h 341, R.A. $17^h\ 59^m\ 36^s$ Dec. $-43°\ 25'·8$ (1900) mag. 5·2 from Bailey's Southern Photometry. Its motion was early recognised, but the measures of Jacob, which we can now see are mutually inconsistent, made it difficult to reconcile all the observations made into even a passable orbit. It will be understood that from Jacob's station the star can only be seen at a comparatively small altitude, and from the closeness of the components and the inferiority of the telescope used it must have been a very difficult pair to deal with. The components are very nearly equal in magnitude; on one occasion Jacob found half a magnitude of difference between them, and on several occasions I have thought the now preceding star slightly the fainter, but it is really doubtful if it is so. I have, however, added 180° to all angles since the time of Jacob, and get thus :—

	Angle.	Distance.		Nights.
	°	″		
1836·7	69·1	0·67	*h*	2–1
1856·7	312·3	0·5 ±	Jacob	1
1857·7	317·2	0·6 ±	„	1
1878·7	268·0	1·38	Melbourne	1
1880·5	259·3	0·81	Russell	1
1886·6	254·8	1·27	Pollock	1
1887·8	253·0	1·38	„	3–2
1893·6	248·1	1·02	Sellors	3
1895·6	247·3	1·47	„	3
1896·6	245·6	1·49	„	3

Some of the measures of distance seem to suffer from large errors of observation. The motion is retrograde. It will be seen that apparent periastron probably took place about 1840–1855, and that in fifty-seven years from the date of discovery half of the angular orbit was described. It looks, however, as if the period was much in excess of twice the number of years already elapsed.

The Melbourne measure, which was probably made by Mr. Ellery, was kindly communicated by Mr. Baracchi, the present Government Astronomer there.

The series of measures made under Mr. Russell's direction is very valuable. This pair has a common proper motion of $0''·14$ per annum towards 208°·6.

One of *h*'s measures is set against *h* 5013, and his identification of the star as *Brisbane* 6308 is also erroneous. The star *Brisbane* 6308 follows and is included with the pair in a low power field.

Royal Observatory, Cape of Good Hope:
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